

Mount Diablo Astronomical Society

Diablo Moon Watch

October 2013

GENERAL MEETING

Tuesday October 22, 2013

The Once and Future Kepler Mission

By Dr. Douglas Caldwell

**Doors open at 6:45 p.m.
Lindsay Wildlife Museum
1931 First Avenue,
Walnut Creek, CA 94597**

**Please park East of the
museum, follow the
instructions on the last page**

We are living in a new golden age of discovery where the goal is not new continents, but entire planets around other stars, or "exoplanets."

Since their first discovery in the 1990s, nearly 1000 confirmed exoplanets have been found along with thousands of other planet candidates. Within the next few years we will know whether planets like the Earth are common or rare in our galaxy and the students in school today won't remember a time when the existence of other solar systems was even in question. NASA's Kepler mission has led the pack in planet discoveries since its launch in March 2009, with 3,600 planet candidates discovered to date. After four years of data collection, Kepler lost the second of four reaction wheels needed to precisely point the telescope, effectively ending the primary science mission. Fortunately, recent work by Ball Aerospace and the science community have identified a way to continue Kepler's contributions to our understanding of exoplanets. Dr. Caldwell will discuss the latest results from the Kepler mission and describe options for continued science operations of the satellite.



Dr. Douglas Caldwell is a Co-Investigator and the Instrument Scientist for the Kepler Mission, an ambitious, space borne telescope that is examining one hundred thousand stars for evidence of orbiting worlds. He works for the SETI Institute (www.seti.org) in the Kepler Science Office at the NASA Ames Research Center. Dr. Caldwell is an expert on one of the most promising schemes for finding small worlds far beyond our solar system: looking for the slight dimming of a star caused when a planet crosses between it and us, known as a "transit." He has been involved in transit experiments since their first attempts in the late 1990s. He began working on a ground-based observatory in California and then led an effort to search

for transiting exoplanets from the South Pole. He joined the Kepler Mission in 2001 and was named Instrument Scientist in 2006. Dr. Caldwell received a BS in Physics from Carnegie-Mellon University and Ph.D. in Physics from the Rensselaer Polytechnic Institute in 1997.

WHAT'S UP

The Messy Skies of Messier

Presented by Kent Richardson

What do you do when you're trying to make some important and timely discoveries of indistinct objects in the night skies and you are frequently bothered by "fuzzy" distractions? If you're Charles Messier, you catalogue the locations of the distractions so you can avoid them in the future. In "The Messy Skies of Messier" we'll take a look at his life and his legacy.'

PRESIDENT'S CORNER

On Top of The World (Part 2)

by Chris Ford

In Part 1 last month, I described a visit to the CFHT telescope and provided a sense of the layout of the different observatories 14,000' high on the summit of Mauna Kea along with some of the physiological aspects of operating at that altitude.

After leaving the CFHT, we drove the short distance up a slight hill to the Gemini (North) telescope which is the sibling of an identical telescope in Chile. Though the distance is not actually that far, it is wise to only walk and move slowly at this height, and there is no shame in driving distances that are easily walkable at sea-level.

This is a huge observatory containing a 8.19 meter reflecting telescope that is very much an exemplar of contemporary observatory practice. For example there are two huge thermal vents circling the base of the dome that open up each evening to bring the observatory interior to operating temperature quickly. Old style solid domes represented by the CFHT are now regarded as thermally quite inefficient and no longer in favor.

In fact, the day we arrived was actually the last day the Gemini observatory was active before it was temporarily taken off-line for re-coating the huge monolithic



The dome of the Gemini North telescope. The two circular vents surrounding the base open vertically in opposite directions to cool the dome interior.

primary mirror. Most of the larger observatories like the CFHT and the Gemini have their own internal re-coating chambers, that involves lowering a mirror assembly to the floor of the observatory, then further down by crane to the coating chamber in the lower levels. Given the many tons these components weigh, this is a highly precise and probably nerve racking operation.

Though we did not see this observatory in operation at night, we did get a chance to explore the interior of this vast structure and appreciate its huge engineering scale. Underneath the observatory floor, there are huge spaces full of heavy engineering tools, a chamber for mirror re-coating, many wiring and pipe runs, and multiple offices and computing facilities. In fact it became clearer that though Mauna Kea is a center for astronomy, engineers and technicians seems to far outnumber actual working astronomers, most of whom use

these instruments remotely from warm comfortable offices.

The 8.1 meter Gemini telescope itself is built on an enormous scale that has to be seen in the real to fully appreciate. The primary mirror has a

focal ratio of only F/1.8 at prime focus, and at the Cassegrain focus has a focal length of 128.12 meters at F/16. At this point a 45 degree tertiary mirror is used to direct the incoming light into one of 4 surrounding detectors. The telescope itself is mounted on a alt-azimuth mounting with a de-rotator to remove field rotation at the Cassegrain focus. (There is no Naysmith focus) The "mirror box" is surrounded by platforms that we climbed up to look at the mirror up close, though it was hard to take a picture as it was mostly covered.



A picture of the interior of the vast dome, showing the thermal vents closed from the inside. I was standing on the actual telescope itself, 30' above the observatory floor to expose this image.

On Top of The World (Part 2) *(Continued from the previous page)*



The base of the 8.19 meter Gemini with the various instruments clustered around a tertiary mirror underneath the Cassegrain focus point. Incoming light is directed into four surrounding instruments accordingly. The stairs lead up to a platform that surrounds the main mirror.



Looking straight up from the observatory floor to the 1-meter secondary mirror. Like the CFHT, the telescope was just too big to even fit in a very wide field 16mm lens.

While talking to the observatory staff in one of the 4 control rooms, the health officer of the observatory administered a blood/oxygen saturation test for everyone in our party, and put two of my colleagues on oxygen to bring their levels up over the low 80% they were currently registering at.

Because we spent quite a lot of time at the CFHT and Gemini, during this visit I did not get a chance to visit the two Keck or Subaru telescopes through we drove past them, and briefly went into the Keck visitor gallery to take a quick look.



On oxygen. Ah, relief!



What do employees of large observatories read in their spare time? Uh, astronomy magazines!



The dome of one of the 10-meter Keck reflectors above the clouds!

On the way down, we made an unscheduled stop at the Sub-Millimeter Array (SMA) to talk to the technicians who run this facility. This specialized non-visible light array unexpectedly turned out to be as fascinating as the giant optical observatories especially when we saw how the staff moved these huge antennae around. Each weighs about 40 tons, and whenever they need repairing they transport them laboriously from the observing site into the workshop for repair, then they haul them right back out again. Les, the technician responsible was a real character who obviously loved his work fixing unexpected problems at 14,000' high for 10 hours, 4 days a week. Best of all his workshop had a control room that was pressurized to the 9,200' level which was a bit of a relief after several hours of breathing air at 40% less pressure than sea level. After 3-4 hours on the summit and several hours in, I was using the pressure breathing techniques we were taught, and but was definitely feeling a bit light headed and probably had a slight altitude sickness. This affects everyone differently, and is quite indiscriminating with olympic level athletes being just as (or even more) susceptible as someone of average or low physical fitness. I made it through the day feeling generally OK and did not need oxygen however, despite being told not to be a hero if I felt unwell. It took a nights sleep for all the odd feelings to fade away however.

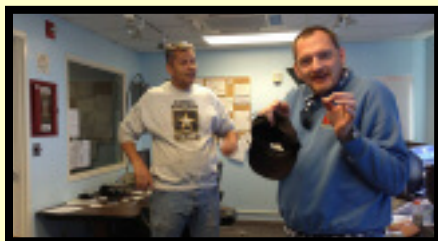
On Top of The World (Part 2) *(Continued from the previous page)*



The Sub-Millimeter Array (SMA)

than the Gemini and CFHT telescopes. In fact pictures of the summit of Mauna Kea do not quite convey how vertically separated the telescopes are when you are actually there. (Though it makes little difference in reality of course)

the clouds drifting *below* you. Arriving at my hotel in a cold weather jacket and thermal underwear when the temperature was 86 degrees and humid even more so. The pressure gradient of descending 14,000' is certainly more severe than in an airliner whose cabin is pressurized to a higher level, and I was almost deaf for several hours before my ears finally popped.



Getting a little stir crazy in the SMA control room! The pressurization in here to the 9,200' level was a relief!

At this point, we finally started our descent, but not before passing the site of the future TMT (Thirty Meter Telescope) which will be far and away the biggest telescope in the world when it is completed around 2020. The site of this telescope will be a little lower than the Keck and Subaru, which in turn are a little lower



Not every road descends into the clouds.

The descent provided evidence to what I had previously been advised, and that was that going down is even more visually spectacular than the ascent. There remains something very unreal to heading down a dirt road with

accessible to arranged tours for the public so if you are physically comfortable at being at such a high altitude, I whole heartedly recommend it.

Clear skies!

Chris Ford

Esa and NASA Stumped by Cosmic Mystery *by the European Space agency*

October 9, 2013

A mystery that has stumped scientists for decades might be one step closer to solution after ESA tracking stations carefully record signals from NASA's Juno spacecraft as it swings by Earth today.

NASA's deep-space probe will zip past to within 561 km at 19:21 GMT as it picks up a gravitational speed boost to help it reach Jupiter in 2016.

During the high-speed event, radio signals from the 2870 kg Juno will be carefully recorded by ESA tracking stations in Argentina and Australia. Engineers hope that the new measurements will unravel the decades-old 'flyby anomaly' - an unexplained variation in spacecraft speeds detected during some swingbys.

"We detected the flyby anomaly during Rosetta's first Earth visit in March 2005," says Trevor Morley, flight dynamics expert at ESA's ESOC operations centre in Darmstadt, Germany. "Frustratingly, no anomaly was seen during Rosetta's subsequent Earth flybys in 2007 and 2011. This is a real cosmic mystery that no one has yet figured out."

Sometimes there, sometimes not

Since 1990, mission controllers at ESA and NASA have noticed that their spacecraft sometimes experience a strange



Juno approaching Earth

variation in the amount of orbital energy they pick up from Earth during flybys, a technique routinely used to fling satellites deep into our Solar System.

The unexplained variation is noticed as a tiny difference in the expected speed gained (or lost) during the passage. The variations are extremely small: NASA's Jupiter probe ended up just 3.9 mm/s faster than expected when it swung past Earth in December 1990.

The largest variation - a boost of 13.0 mm/s - was seen with NASA's NEAR asteroid craft in January 1998. Conversely, the differences during swingbys of NASA's Cassini in 1999 and Messenger in 2005 were so small that they could not be confirmed. The experts are stumped.

ESA stations listen for Juno

On October 9, engineers and the flight dynamics teams at ESOC will watch closely as the Agency's new 35 m-dia-

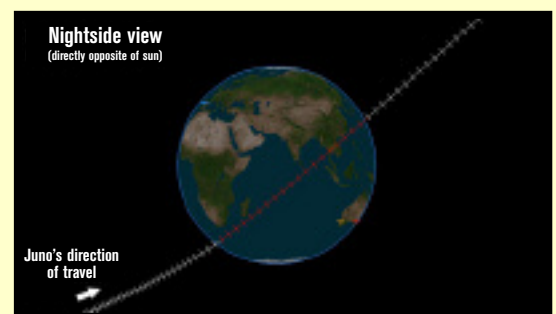
ter deep-space dish in Malargüe, Argentina, and a smaller 15 m dish in Perth, Australia, track Juno starting at about 16:00 GMT.

The stations will record highly precise radio-signal information that will indicate whether Juno speeds up or slows down more or less than pre-

dicted by current theories. The results will be studied closely by ESA and NASA as well as scientists worldwide, who are hoping to see whether the anomaly is again detected.

"Our Malargüe station is designed to track very distant and relatively slow-moving spacecraft, while Juno will pass by moving very, very fast at just 561 km altitude," says ESA's Daniel Firre, responsible for the tracking support at ESOC.

"This makes tracking Juno technically very challenging, but it's how the scientific process works. Gathering more data that can be analysed by experts is critical if we are ever to solve this perplexing mystery."



Juno trajectory past Earth

Mount Diablo Astronomical Society Event Calendar–October 2013

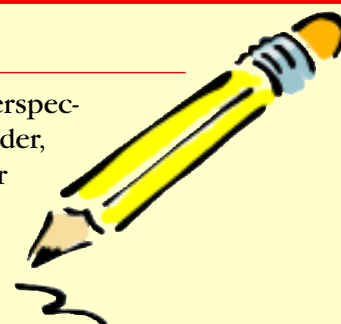
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
29	30	3:30 PM Educator's Fair 1	7:00 PM Silicon Valley Lectures 2	3	World Space Week 4	World Space Week 5 Society Observing (Private) Sunset: 6:46 PM 
World Space Week 6	World Space Week 7 Board Meeting (Private)	World Space Week 8 7:00 PM Moraga Stargazing	3 events: Click here to view 9	World Space Week DVMS Stargazing (Private) 10	11 	Observe the Moon Night 8:00 PM Public Astronomy 12 Sunset: 6:34 PM
13	Columbus Day 14 7:00 PM San Pablo Library Astro	6:30 PM Seek the Unknown 15	16	17	18 	19 Sunset: 6:25 PM
20	21	7:15 PM GenMig: 22 Kepler Results	23	Bay Area Science Festival 24	Bay Area Science Festival 25	Bay Area Science Festival 26 Observatory Maintenance (Private) Sunset: 6:17 PM 
Bay Area Science Festival 27 12:00 PM BASF Solar Observing LWM	Bay Area Science Festival 28	Bay Area Science Festival 29	Bay Area Science Festival 30	Bay Area Science Festival 31	1	2

As Always Writers Are Wanted

We are always looking for new articles and content. If you have astronomical perspectives or experiences to share with your fellow members that you would us to consider, please feel free to contact me Chris (cford81@comcast.net) or our newsletter editor Vianney. (veloroute@hotmail.com)

Clear skies!

Chris and Vianney



Mount Diablo Astronomical Society Event Calendar—November 2013

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	29	30	31	Bay Area Science Festival 1	Bay Area Science Festival Society Observing (Private) 2 Sunset: 6:09 PM
3	Board Meeting (Private) 4	5	7:00 PM Silicon Valley Lectures 6	7	8	9 Sunset: 5:02 PM
10	Veterans Day 11	12	13	14	15	16 Sunset: 4:57 PM
17	7:00 PM Hercules Stargazing 18	7:15 PM GenMtg 6:30 PM Dougherty Astronomy Night 19	20	21	22	Society Observing (Private) 23 Sunset: 4:53 PM
24	7:00 PM Concord Library Astro 25	26	27	Thanksgiving Day 28	29	Society Observing (Private) 30 Sunset: 4:51 PM

Board Members & Address

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General Meetings:

Fourth Tuesday every month,
except on the third Tuesday in
November and December.

Refreshments and conversations at 6:45 pm;
Meeting begins at 7:15

Where:

Lindsay Wildlife Museum

1931 1st Avenue

Walnut Creek, CA 94597

(925) 935-1978

wildlife-museum.org.

Directions to facility:

From the North: Take 680 South to Treat Blvd.
exit. Turn left at light onto North Main St. Turn
right on Geary Road. Turn left on Buena Vista.

Turn right on First Avenue. The museum is
halfway up the block on the left.

From the South: Take 680 North. Take the Treat
Blvd./Geary Road exit and turn left over free-
way. Go three more lights and turn left on
Buena Vista. Turn right on First Avenue. The
museum is halfway up the block on the left.

Parking:

The museum is located in a residential area.
There are no parking fees nor meters. Please
park only in the museum parking lots on the
east side of the museum, the Friends Church lot
across the street (except Sunday mornings) or
on Buena Vista Avenue. Please do not park on
First Avenue in front of our neighbors' homes
— you will get a parking ticket.

